



Paediatric Intensive Care unit Nursing Procedure: Care of the ventilated child

All nursing staff should read this policy to inform themselves of relevant areas prior to undertaking any aspect of care related to care of an intubated / ventilated patient in PICU.

STANDARD

- Only qualified nurses who have satisfactorily completed The Paediatric Intensive Care Orientation Programme and Competency booklet may independently care for a ventilated infant / child.
- Any concerns or marked changes to the patient's condition should be reported immediately to medical staff and the nurse in charge.

Indications For Mechanical Ventilation

Primary indications include:

- Depressed or absent respiratory drive secondary to medications or central nervous system injury.
- Inadequate peripheral neuromuscular function including: phrenic nerve lesions and muscular dysfunction.
- Upper or Lower airway obstruction
- Airway protection
- Acute management of increased intracranial pressure

BEDSIDE SAFETY

The bed safety checklist must be fully completed at the commencement of each shift (see attached)

Important – It is essential that every patient has name bands insitu, with the correct information.

- The minimum safety requirement at each patient bedspace must include
 1. Resuscitation equipment (Ayres T piece or Waters circuit and ambu bag with oxygen tubing attached
Oxygen ports readily available and working fully
Age appropriate sized silicone face masks and Guedel airways,
3 spare ET tubes one the same size, one size smaller and one size larger)
 2. Suction equipment, check is set up and functioning correctly.
Appropriate sized suction catheters present (size is double that of the ET tube), plus an age appropriate size Yanker sucker.
Parameters for suction pressure levels can be found in the bedside folders (PICU Practice guidelines).

3. A portable oxygen cylinder must be in the bedspace and must be over half full; this is for emergencies only if inbuilt oxygen fails or for evacuation of the unit.
These cylinders are not to be used for transport of patients to the wards.
4. Individualised Emergency drug checklist completed and checked by medical staff.
5. Check a ventilator is connected to a power source and the gas supply is set up correctly. The ventilator must also be tested before being used, each Servo I there is a pre-use check test to be performed before use for each patient, always unsure it has passed before use.
6. A stethoscope.
7. Monitor alarms must always be left on and set at appropriate limits consistent with patient's clinical condition and age.

CARE OF THE PATIENT

- Intubated and ventilated patients must not be left unattended. When the Staff nurse has to leave the bedside, another staff member must be informed and be available to supervise.

Preferentially critical airway patients, e.g., croup, new tracheostomy, etc and patients receiving paralysing agents should be nursed 1:1 patient / nurse ratio not left unattended. There will be occasions when the patient will be under the supervision of a nurse with a 2:1 patient / nurse ratio. This should only occur following discussion with senior staff nurses or medical staff.

- Bed/Cot sides should always be raised when the patient is unattended or unless direct care is being delivered.
- The Ventilators currently used on the unit are the Servo i/s. This policy is for use with these ventilators, other forms of ventilation such as high frequency oscillation, Bipap via the Vision machine and the Infant Flow drivers have separate nursing policies which all nursing staff must be familiar with and refer to them when nursing a patient on such equipment.
- At the commencement of each shift ventilator setup should be checked, ventilator alarms set and checked, plus a full respiratory assessment of the patient undertaken and recorded on the observation chart.
- Ventilation observations and humidification temperature are recorded hourly; other observations must be individualised to ensure the patient receives appropriate observation and documentation of care.

Y = parameters to record each hour

SERVO 300	Mode	FiO ₂	Set Rate	Peak PIP Press (pt)	PE EP (pt)	TV In/ex (pt)	EM V	Set IT	Set PS	Set PC	Set PEEP	Humd . Temp	Set TV In/Ex	Set Min Vol	Re sp. (pt)	T r i g
PC	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y			Y	Y
VC	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y
PRVC	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y

VS	Y	Y		Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y
SIMV VC/PS	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SIMV PC/PS	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y
PS/CPAP	Y	Y		Y	Y	Y	Y		Y		Y	Y			Y	Y

Pt = Patient (What is actually being delivered to the patient) PIP = Positive inspiratory Pressure
Set = What is actually set on the ventilator by the medical staff PEEP = Positive End Expiratory Pressure
TV = Tidal volumes (inspiratory and expiratory) PS = Pressure Support
EMV = End Minute Volume PC = Pressure Control
IT = Inspiratory Time

- Any changes made to the ventilation by the medical team must be noted on the observation chart in red pen.
- Ventilators currently used on the unit are the Servo – i/s

Ensure the correct ventilator tubing is used
For patients < 0 - 5kg a **small (neonatal) circuit (15mm diameter circuit)**
For patients **greater than 5-40kg (paediatric) (22mm diameter circuit)**
All paediatric ventilator circuits are wet circuits, i.e. should be humidified.
>40kgs Adult ventilator tubing is available and to be used with a HME filter.
Dry circuits are to be changed to a WET circuit after one week.

These ventilators come with a pre used check test, please ensure that the test is performed and passed prior to use on each patient.

- New nurses to the unit must ensure they have been assessed and are competent in the set up of the ventilators, prior to setting them up.
- The water trap should be emptied when necessary and must never contain more than ¾ of its capacity, once emptied ensure the water is immediately disposed of for infection reasons.
- Corrugated flexible connectors / catheter mounts between the ETT and the ventilator have a large dead space and should not be used in patients under 10kgs, unless requested by medical staff.
- Manometers can be used when hand ventilating patients, although not routinely used. The purpose of their use is to ensure the peak pressure the patient is being ventilated on is not exceeded.
- The maximum period of use of a ventilator circuit is to be weekly. The changing of the circuit is to be documented on the weekly changes sheet.
- Acute desaturation and/or loss of ETCO2 trace should be regarded as ventilator malfunction or ETT blockage or dislodgement. Immediate action is to disconnect the patient from the ventilator, hand ventilate and seek assistance.

HUMIDIFICATION

Humidification is provided using the Fisher Pakel humidifiers.

- All humidifiers used in PICU utilise a water feed set with a 1 litre bag of sterile water. The level of water should be checked hourly and adjusted accordingly.
- The desired inspired gas temperature to the patient is 37 degrees C

- The temperature control on the humidifier to be set at 39 degree C and the chamber control dial set at minus 2 degrees C
- The gradient (between the humidifier and the temperature probe closet to the ETT) ensures that the delivered airway gas is at body temperature 37 degrees C.
- The temperature sensor in the circuit is to be placed away from any direct heat source.
- Condensation should always be present in the expiratory limb of the ventilator circuit, but ensure it does not become excessive.
- The water bags for the humidifiers should be hung at the same level as the humidifier to prevent excess water filling in to the humidifier drowning the ventilator circuit.

END TIDAL CO₂ MONITORING

- Assessment of the need to use capnography with a specific patient should be guided with each given clinical situation and individual patient.
- At present the ETCO₂ monitoring equipment includes single use water trap and sampling line using the bedside monitor or the module included in the servo i.
- Contamination of the sampling lines by secretions or condensate, or obstruction of the sampling chamber can lead to unreliable results. Subsequently it may be necessary to replace the ETCO₂ sensor if these situations arise.
- A normal capnogram has a characteristic appearance that represents the various phases of carbon dioxide elimination in the lungs during exhalation. For practical purposes it should look like a square wave and if it doesn't it cannot be relied on to give accurate reflection of arterial CO₂. Any alterations in the visual waveform may indicate deterioration in the patient's condition and requires immediate assessment.
- If an ETCO₂ sensor is in place, consideration must always be given to the resulting deadspace and the impact of this on the patient's respiratory drive.

GENERAL INFORMATION

- A useful mnemonic that is beneficial in ascertaining the potential causes of airway / ventilation problems in intubated patients is 'DOPE' and should be utilised when a acute deterioration occurs.

D: Displaced ETT
O: Obstructed ETT
P: Pneumothorax
E: Equipment failure

- The first line of intubation is via oral route, this is quicker and potentially less traumatic. Only when the patient is stable and can safely tolerate having their airway interrupted should nasal intubation be considered.
- For intubation nasal tubes are used on the unit unless there is a good contraindication such as basal skull fracture, choanal atresia or severe coagulopathy.
- Mostly on the unit for children under 12 years old uncuffed tubes are used, however some small cuffed tubes are available, if requested by the consultant.
- Correct tube position is confirmed by visual and auscultatory confirmation of chest expansion and CO₂ monitoring.

NB. IF IN DOUBT TAKE IT OUT

And resume bag and mask ventilation

- Tube security must be ensured by the application of elastoplast tape using the trouser technique. If the strapping is loose or saturated with secretions, ensure the ETT is resecured as soon as possible.
- If visible ensure that the ETT tube is taped at the measurement documented on the front of the observation chart.
- Avoid kinking by positioning ETT and ventilator tubing dependant to the patient to minimise traction and the potential for excess condensation to enter the airway.
- Each bedspace contains an adjustable tubing holder, which must be used for greater tube support and security
- Suctioning is to be assessed and performed according to the individual needs of the patient.
- All staff should review the patient's chest X- ray.
- The most important monitoring for ventilated patients is capnography and pulse oximetry.
- Arterial blood gases should be performed where clinically indicated. At present it is the Doctors or trained staff nurses who have completed the competency assessment for arterial blood gas sampling. The bedside nurse must be competent in understanding the result, which are documented on the observation charts.
- The physiotherapists are a vital part of the team, attending the morning ward rounds, then visit and treat patients on the unit through the day and on call overnight.

COMPLICATIONS

- Barotrauma / Volutrauma
 1. Can develop from the use of excessive inflating pressures and/or tidal volumes.
 2. Clinical signs may include deterioration in oxygenation, decreased chest expansion or breath sounds with an increased resistance to hand ventilation.
- Oxygen Toxicity
 1. Can develop from the delivery of inspired oxygen at levels greater than those required.
- Atelectasis
 1. May occur when there is partial or complete volume loss in a lung or lobe, which can potentiate ventilation/perfusion mismatches.
 2. Clinical signs may include decreased bilateral air entry, changes on chest x-ray, decreased tidal, volume measurements, increased airway pressures, increased O₂ requirements or abnormal breath sounds.
- Hypoxemia
 1. Underlying causes may be difficult to ascertain.
 2. Clinical signs may include cyanosis, tachypnoea, pulmonary hypertension, decrease in oxygen saturation, restlessness and agitation, marked increase in CVP or decreased PaO₂.

- Hypercarbia
 1. Underlying causes may be difficult to ascertain.
 2. Clinical signs may include increased ET CO_2 or increased Pa CO_2 .

- Infection

Can develop in the critically ill child who is already immuno compromised. Patients in the PICU are exposed to numerous invasive devices and procedures predisposing patients to risk of infection.

 1. Clinical signs may include an increase in core temperature, tachycardia or marked change in tracheal secretions (colour and consistency).

- Endotracheal tube displacement
 1. Can develop from accidental dislodgement caused by inadequate securing or due to unplanned extubation.
 2. Clinical signs may include decreased oxygen saturation, marked decrease in air entry and chest movement, marked decrease in tidal volumes or patient verbalising sounds.

- Ventilator malfunction complications
 1. Can develop from ventilator alarms being inactive or not functioning resulting in the lack of detection, gas and/or power supply malfunction.
 2. Clinical signs may include sudden deterioration in the patient's vital signs.

OUTCOME

Oxygenation, ventilation and gaseous exchange will be maintained optimising the potential for the restoration of effective breathing patterns and acceptable lung compliance whilst attempting to minimise and prevent complications associated with mechanical ventilation.

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